China's output of primary chemicals is quite high and rising from year to year. The chemical industry in China is developing very fast, while its output and trade value are increasing steadily. There are nevertheless some problems that still have to be solved.

A brief introduction to China's chemical industry

China's chemical industry accounts for an impressive 10% of GNP. Traditional chemicals based on coal, metal ores, salt and organic compounds account for 48% of the total, followed by petrochemicals and natural gas (20%), pharmaceuticals (17%), chemical fibers (9%) and commodities (6%). The total production value of China's chemical industry is increasing at 8-9% per year. Sales in 2001 were worth a total of RMB 60.3 million, which was 8.6% more than those for the previous year. There are tens of thousands of chemical corporations in China, more than 10,000 of which are joint ventures. Some USD 30 billion are invested in China's chemical industry every year, with foreign investment accounting for 55-60% of this amount. There are nearly 80 different chemical stocks on the market, or 137 if petrochemicals and fibers are also included. Imports and exports are also increasing fast, with imports totaling USD 32.75 billion or 14% of the total — and exports USD 19.45 billion in 2001. Although these facts are impressive, there are still some problems to be solved. Here are some examples of the kind of problems we are talking about.

Fertilizer industry

As China's nitrogen, phosphorus and potassium resources are not enough to satisfy agricultural development, large amounts of phosphorus and potassium have to be imported from abroad. High-concentration fertilizers, composite fertilizers, special fertilizers and multi-usage fertilizers take a long time to develop and outputs are very low. The plethora of small workshops that make these products are very inefficient and waste a lot of energy.

Petrochemicals

Although petrochemicals (including the ethylene industry) now have a solid base in China, it still lags far behind the petrochemicals industry in the developed world. China currently produces some five million tons of ethylene per year, but consumes nearly twice that amount. Small-scale production (seven plants with an output of 140,000 tons per year) makes the ethylene industry very inefficient.

Organic chemicals

Organic chemicals have to be imported on a large scale — meaning some 16.2 million tons in 2001, or 24.6% more than in 2000. These imports cost USD 8.86 billion or 6.8% more than in 2000. The most important organic imports are propylene, benzene, toluene, methyl alcohol, butyl alcohol, octyl alcohol, glycol, acetic acid, acrylic acid, acrylate, methyl ethyl ketone, phenol, anhydrides, etc., while imports of the monomers of synthetic materials such as styrene, PX and PTA are also very substantial. The factories for producing organic chemicals in China are too small and some of them too obsolete to be able to compete on the world market. A plant that produces methyl alcohol, for example, would have to produce at least 300,000 tons per year to be competitive, while many of those in China produce only 10,000 tons per year. This means that the production costs are often higher than the costs of importing, which is why so many plants have had to be shut down.

Synthetic materials

Although China produced 7.9 million tons of resin in 2000, this was enough to meet only half the demand. The other half had to be imported. Synthetic fibers developed very fast in the 1990s, with polyester, PAN, PP and polyamide accounting for most of the output. With a synthetic fiber output of 7.6 million tons, China is now one of the world's largest producers. Despite this, its products continue to fall short of market requirements, nor does it produce a wide enough range of special and high-quality fibers. China's 15 synthetic rubber factories, for example, together have a capacity of one million tons per year, but produce mainly SBR and BR, while other high performance products are made only in very small quantities.

Fine chemical industry

Thanks to the hard work of over half a century, China now produces more than 30,000 different kinds of fine chemical. Not only is it now the world's largest producer of dyes, but it is also the second largest producer of pesticides and composite feedstuffs and the sixth largest producer of dope. Yet China's fine chemical industry still lags far behind that of the developed world. The technology and equipment now being used in China are the same as those the developed world was using 15 or 20 years ago. Deoxidization with hydrogen, continuous nitrification, cold nitrification and sulfurization with liquid trioxide sulfur have not been adopted on a large scale. Many factories are really just workshops with reaction routes, cell operation and product purification at the level of the 1960s and 70s. The use of automation and DCS control also falls far short of that customary in the modern world. Some products in fields that
are only just developing – such as functional polymers, fine ceramics, liquid crystals, information chemistry and nano materials – are still very weak. Because China’s own output lacks both quality and diversity, it is still heavily reliant on imports. Its own exports, meanwhile, are mostly low in quality and hence low in price. There are over 10,000 factories for fine chemicals in China, but most of them are so backward in terms of scientific research and pollution management that they are unlikely to be able to compete on the world market.

**The chemical industry’s future prospects**

China’s chemical industry will have to develop more high-concentration fertilizers, including DAP and NPK composite fertilizer, to rebuild many of its medium-sized fertilizer factories and build large fertilizer plants in areas that are rich in natural gas, sulfur and phosphorus. The petrochemicals industry and ethylene production especially has been affirmed as an industry of national economic importance and has made great progress in recent years. Efforts are being made to increase the output of ethylene to nine million tons per year and to increase China’s ethylene self-sufficiency rate from 43% to about 60%. The Chinese government is encouraging foreign investment in large ethylene plant and many of these, such as Nanjing Yangzi/BASF (800,000 tons ethylene per year), Shanghai Petrochemical Company/BP (900,000 tons ethylene per year), Huizhou National Offshore Oil Corp/Shell (600,000 tons ethylene per year) have already been built. A number of others, such as Fujian Petrochemical Company/Exxon, Tianjin Petrochemical Company/Dow, Lanzhou Petrochemical/Phillips, are still in the pipeline. These will increase production capacity, optimize product quality, enhance competitiveness, increase recycling rates and reduce costs. In organic chemicals, it is time to drop such obsolete methods as sulfurization, the use of alkaline salts to make phenol and use of fermentation to make solvents (acetone, butyl-alcohol). Transferring the production of organic chemicals to petrochemicals would certainly be useful, as long as the importance of modern coal-based chemicals is not underestimated. Water gas can be used to make methyl alcohol on a large scale, for example, while methyl alcohol can be carbonylized to produce acetic acid; bioengineering also deserves greater recognition, as both alcohol and propylene glycol can be produced by recycling.
The fine chemicals industry should pay a lot more attention to those exiguous products that are nevertheless vital to national economies. This means products such as methionine, lysine, pantothenic acid, calcium, vitamins (E, A, D, etc.) in food additives, L-lactic acid, behenic acid, nucleic acid, safe fat and artificial sweeteners, new types of enzyme, biodecomposed polymers, long-line acetic acid and new biological pesticides made of biochemicals.

China currently produces over 30,000 fine chemicals, most of which are produced far apart and only in very small quantities. Its development strategy for fine chemicals should therefore be to strengthen its scientific and technological base, if necessary by upgrading its chemical engineering first.

Conclusion

The chemicals mentioned above are not the only chemicals produced in China, although the 60 items mentioned do point to a flourishing industry with tremendous potential. In terms of size and investment volumes, China’s chemical industry enjoys a leading position worldwide. Petrochemicals are still a key focus of construction and investment, while the demand for some coal-based chemicals is still heavy, thanks largely to the fertilizer industry. The most important chemical products currently being made are synthetics and above all synthetic resins and man-made fibers, both of which are needed urgently and in large amounts. Basic organics are also very popular, especially the three ethylene bases and their appendages. These are now receiving a leg-up from a joint venture involving international corporations of worldwide renown on the one hand, and powerful Chinese companies on the other. Together, these are setting up production plant for ethylene that will enable China’s petrochemical industry to catch up with the rest of the world and improve significantly both the quantity and quality of its products.